

FACTORS RELATED TO TROPHIC UPSURGE OF WEST POINT LAKE

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INTRODUCTION

West Point Lake, a 10,467 ha impoundment on the Chattahoochee River near West Point, Georgia, first reached full pool in June 1975. Both pre and post impoundment studies warned of the potential for accelerated eutrophication of the lake caused by discharge of treated wastewater from upstream treatment plants and the release of untreated waste during rainfall events resulting from combined sewer overflow in the Atlanta metropolitan area (Schneider et al. 1972, Vick et al. 1976). Our study was designed to measure biological response of the lake to nutrient enrichment from June 1976 through March 1990.

METHODS

Four mainstem sampling stations, extending from the dam to the headwaters at Franklin, Georgia, and two tributary embayment stations (Yellowjacket and Wehadkee Creeks) were sampled twelve times each year (3 consecutive days each quarter) (Figure 1). Water quality data were collected at each sampling station. Additional water quality data were obtained from the Georgia Department of Natural Resources, Environmental Protection Division (EPD).

Phytoplankton chlorophyll *a* concentrations were measured to estimate biomass and phytoplankton identification and enumeration were used to determine community structure. Measurement of phytoplankton primary productivity using the carbon-14 method was considered the most sensitive indicator of lake trophic status.

Records of total effluent discharge and 5-day biochemical oxygen demand (BOD₅) of wastewaters entering the Chattahoochee River between Buford Dam, located northeast of Atlanta, and West Point Dam were acquired from EPD. Mean quarterly inflow rates of waters entering West Point Lake were calculated from monthly values provided by the U. S. Geological Survey for the Whitesburg, Georgia gaging station on the Chattahoochee River.

SUMMARY

From 1976 through 1981 mean annual phytoplankton primary productivity varied between 550 and 730 mg C m⁻² d⁻¹ (Figure 2). Bayne et al. (1983) reported extreme spatial and temporal variation in primary productivity and chlorophyll *a* during the first 4 years of the study. A dramatic increase in productivity began in 1982 and reached a peak in 1985, a trend that resulted in a change in status of the lake from mesotrophic to eutrophic. From 1982 through 1984 the increase in productivity was not accompanied by increases in phytoplankton chlorophyll *a* concentrations (Figure 2). Bayne et al. 1990 reported that during this period a shift in algal dominance from relatively large diatoms to relatively small green and blue-green taxa resulted in improved photosynthetic efficiency and greater productivity per unit chlorophyll *a* present. Shifts in size distribution of phytoplankters are thought to be mediated by phytophagous fishes (*Dorosoma* spp.) that have been captured in cove rotenone samples in West Point Lake at biomasses exceeding 1 ton acre⁻¹ (2,241 kg ha⁻¹). The role of vertebrate predators in structuring lake plankton communities has been well documented (Mills and Forney 1988 and Persson et al. 1988).

Phytoplankton primary productivity was significantly ($P < 0.05$) related to volume of Chattahoochee River inflow to West Point Lake based on multiple linear regression analysis of primary productivity and twelve independent limnological variables (Bayne et al. 1990). The influence of river inflow on productivity is complex. For example, rainfall on the watershed (increased inflow) would likely cause increased urban runoff and combined sewer overflows that would increase nutrient loading of the lake. Decreased inflows would increase water retention time and result in concentration of nutrients being continuously discharged into the lake. Lower inflows would also be accompanied by less abiotic turbidity and improved light conditions for photosynthesis. Regression of mean primary productivity of West Point Lake on Chattahoochee River inflow revealed a tendency towards increased productivity at lower inflows ($R^2 = 0.15$; $P < 0.0001$) although obviously other variables also influence productivity.

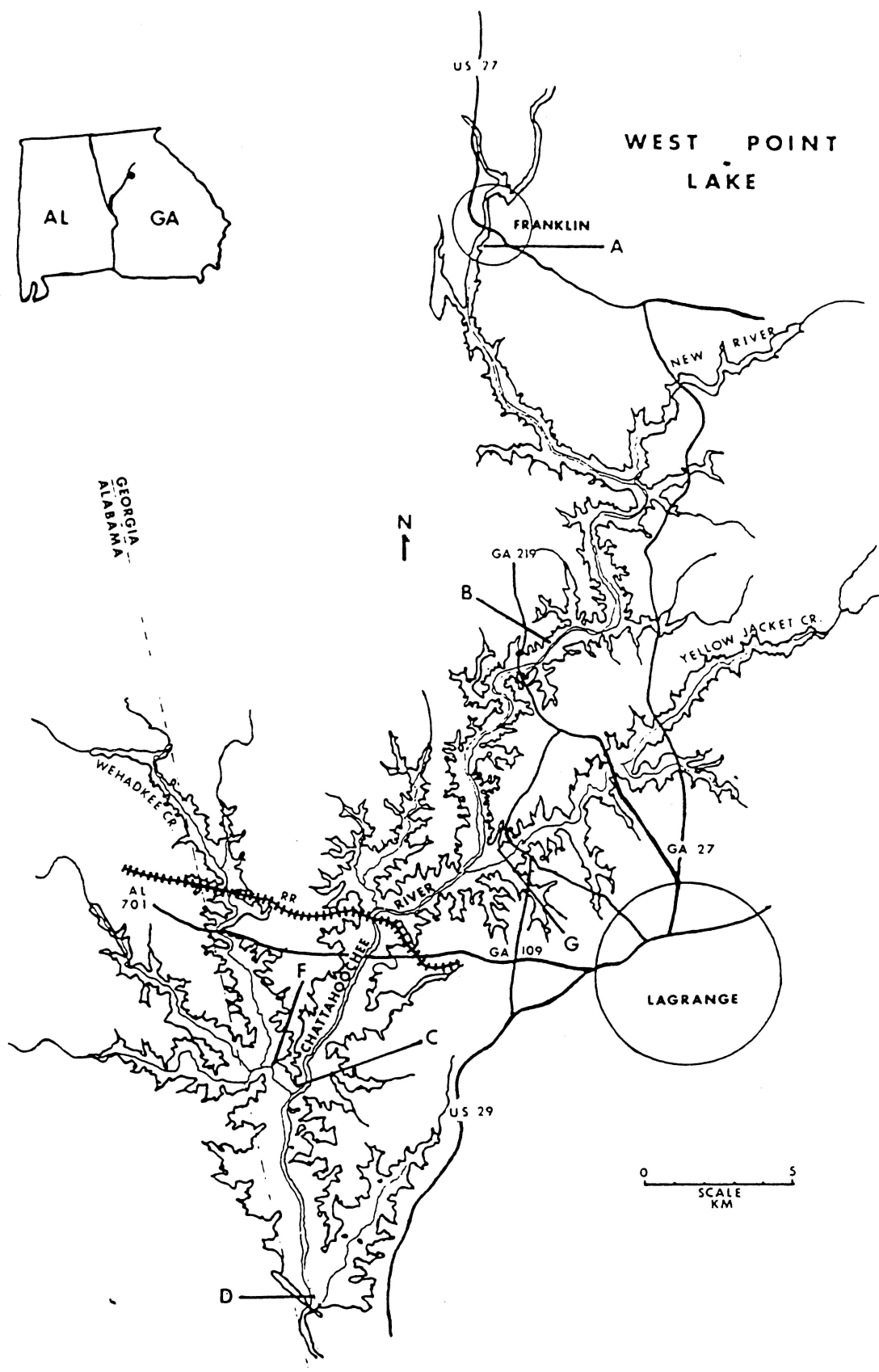


Figure 1. Map of West Point Lake showing sampling stations.

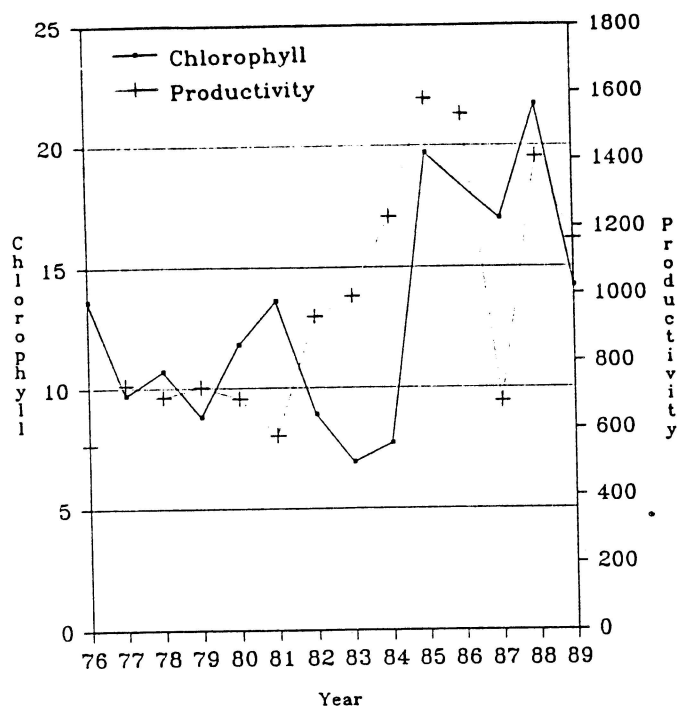


Figure 2. Mean annual trends in photic zone chlorophyll *a* concentrations ($\mu\text{g l}^{-1}$) and phytoplankton primary productivity ($\text{mg C m}^{-2} \text{d}^{-1}$) in West Point Lake for the period 1976 through 1989.

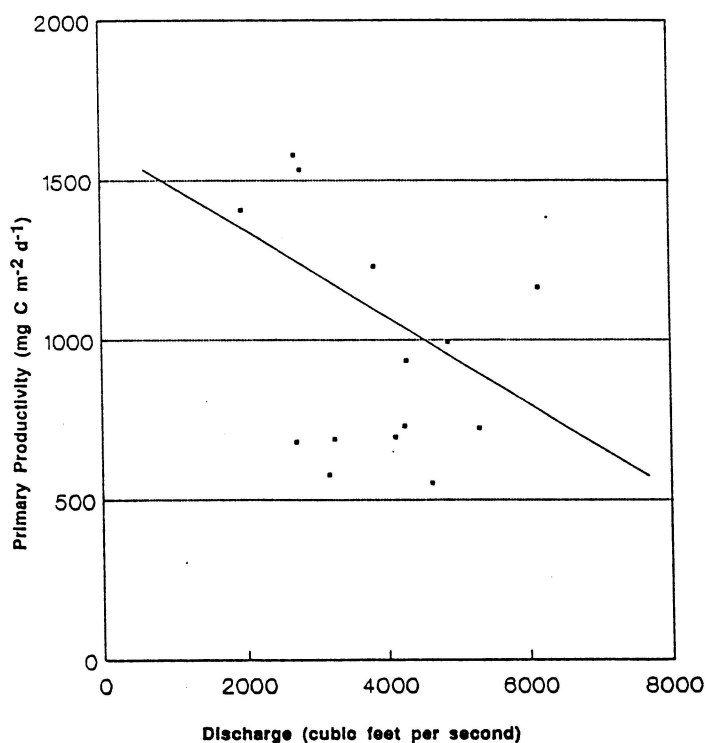


Figure 3. Regression of mean phytoplankton primary productivity of West Point Lake on Chattahoochee River discharge at Whitesburg, Georgia gaging station.

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